422325

FLOOD INSURANCE STUDY

FEB 3 1981

BOROUGH OF PATTERSON HEIGHTS, PENNSYLVANIA
BEAVER COUNTY

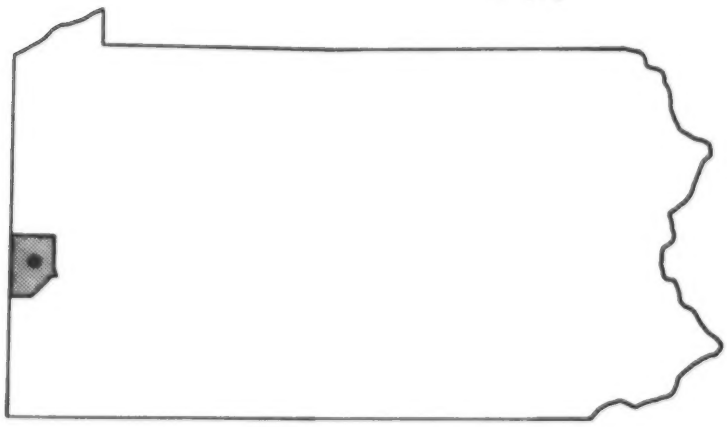

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TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgements	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	5
3.0	ENGINEERING METHODS	5
	3.1 Hydrologic Analyses	6
	3.2 Hydraulic Analyses	7
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	8
	4.1 Flood Boundaries	8
	4.2 Floodways	9
5.0	INSURANCE APPLICATION	11
	5.1 Reach Determinations	11
	5.2 Flood Hazard Factors	12
	5.3 Flood Insurance Zones	12
	5.4 Flood Insurance Rate Map Description	14

TABLE OF CONTENTS - continued

	Page
6.0 OTHER STUDIES	14
7.0 LOCATION OF DATA	14
8.0 BIBLIOGRAPHY AND REFERENCES	14

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Floodway Schematic	11

TABLES

Table 1 - Summary of Discharges	6
Table 2 - Floodway Data	10
Table 3 - Flood Insurance Zone Data	13

EXHIBITS

Exhibit 1 - Flood Profiles Beaver River	Panel 01P
Exhibit 2 - Flood Boundary and Floodway Map	

PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
BOROUGH OF PATTERSON HEIGHTS, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Borough of Patterson Heights, Beaver County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Patterson Heights to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Green International, Inc., for the Federal Insurance Administration, under Contract No. H-4759. This work was completed in December 1979.

1.3 Coordination

On April 19, 1978, the stream to be studied by detailed methods was identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of the FIA, the Borough of Patterson Heights, and Green International, Inc. (the study contractor). During the course of the study, representatives of the

Pittsburgh District of the U. S. Army Corps of Engineers (COE), the U. S. Geological Survey (USGS), and the borough were contacted to obtain hydrologic and hydraulic information used in this report. On May 14, 1980, a final CCO meeting was held with representatives of the FIA, the borough, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Borough of Patterson Heights, Beaver County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The Beaver River was studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through December 1984.

2.2 Community Description

The Borough of Patterson Heights is located in the central portion of Beaver County in southwestern Pennsylvania. It is approximately 25 miles northwest of the City of Pittsburgh on the west bank of the Beaver River. Patterson Heights is bordered by the Borough of New Brighton to the east, the Township of Patterson and the City of Beaver Falls to the north, and the Township of Patterson to the west and south. The population was estimated to be approximately 752 in 1975, and is expected to decrease to 744 in 1980 and increase to 760 in 1985 (Reference 1).

The Beaver River, with a drainage area of approximately 3,100 square miles, flows north to south along the eastern edge of the Borough of Patterson Heights. The flood plain within the borough has no residential, commercial, or industrial development. All residential development is outside of the flood plains.

The Borough of Patterson Heights is located within the Allegheny Plateau physiographic region and is characterized by V-shaped valleys and steep hillsides. Residential land use, open space, and woodland predominate in the community. Soils are generally silt and silty clay loams and exhibit low infiltration capacities (References 2 and 3).

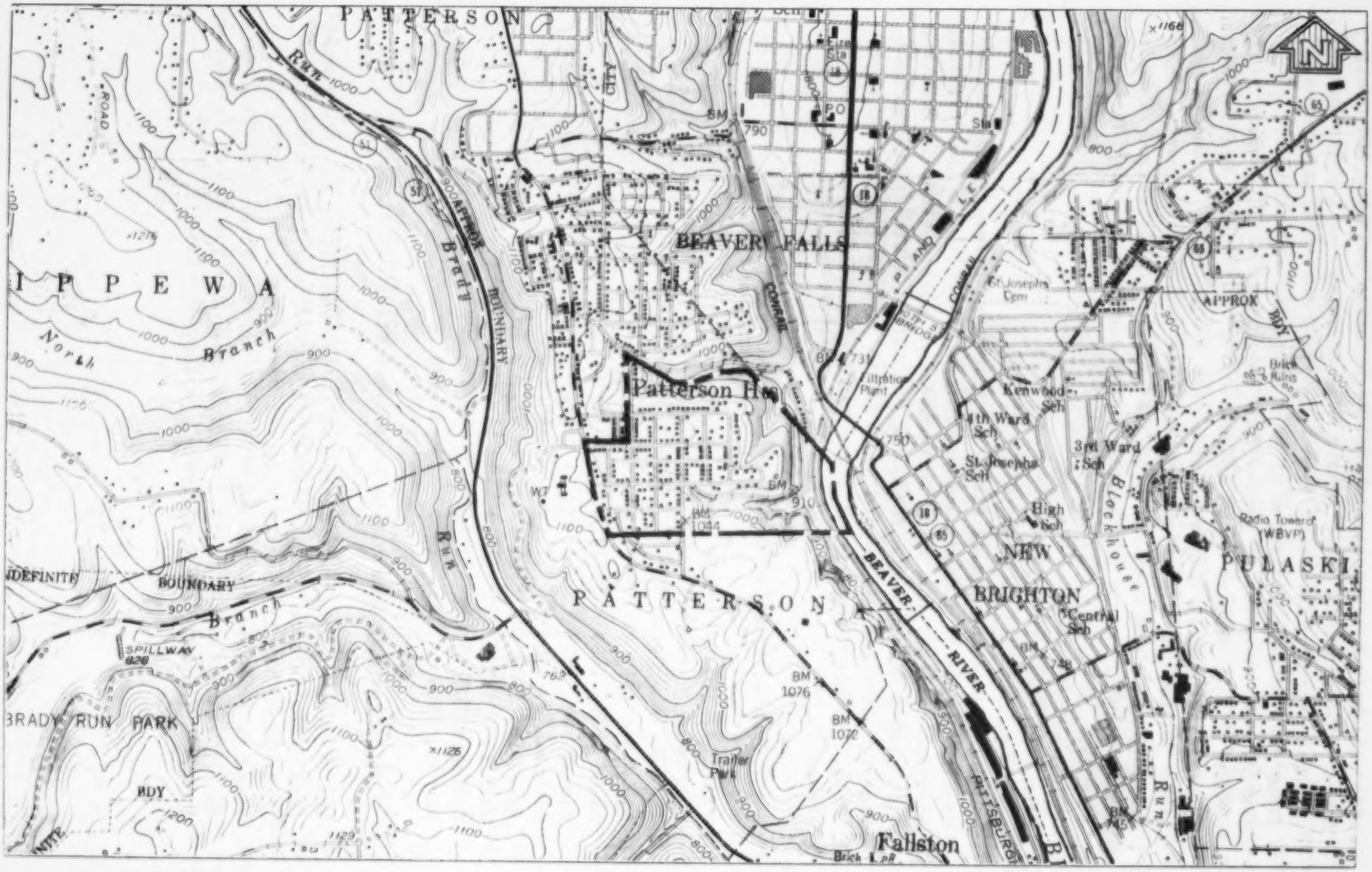


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF PATTERSON HEIGHTS, PA
(BEAVER CO.)

APPROXIMATE SCALE
2,000 0 2,000 4,000 6,000 FEET

VICINITY MAP

The climate of Patterson Heights is humid continental, but is modified slightly by its nearness to the Atlantic Seaboard and Great Lakes. The prominent type of air mass activity has a polar continental source originating from Canada and the Rocky Mountains. There are frequent invasions of warm humid air from the Gulf of Mexico. The temperature ranges from an average of 30 degrees Fahrenheit (°F) in January to an average of 74°F in July. Precipitation is distributed well throughout the year and averages 36 inches per year. During the winter months, snowfall averages 46 inches, which accounts for about one-fourth of the yearly precipitation. Thunderstorms normally occur during all months except mid-winter (Reference 4).

2.3 Principal Flood Problems

Flood flows on the Beaver River are generated primarily by low intensity storms of long duration. Floods often result from tropical maritime systems, including hurricanes, or spring snowmelt combined with precipitation. The following tabulation lists the eight most significant floods of record as recorded at Beaver Falls, Pennsylvania, 0.2 mile upstream of the Borough of Patterson Heights (Reference 5).

Beaver River at Beaver Falls, Pennsylvania[1]

Date of Flood	Gage Height (feet)	Discharge (cfs)	Approximate Recurrence Interval (years)
March 27, 1913	17.4	105,000	150
January 22, 1959	14.4	70,100	26
January 25, 1937	13.8	64,500	16
October 16, 1954	13.3	58,800	11
March 10, 1964	13.2	57,900	10.5
January 27, 1952	13.2	57,100	10
December 30, 1942	13.2	57,000	10
May 28, 1946	13.0	56,200	7.9

[1] Non-recording gage prior to December 3, 1941

The recurrence intervals estimated in the tabulation are the result of a graph relating known discharges versus associated recurrence intervals. For the Beaver River at Beaver Falls, the March 1913 flood is the flood of record with a recurrence interval estimated to be approximately 150 years. The most recent major flood, in January 1959, corresponds to approximately a 26-year flood.

2.4 Flood Protection Measures

Flows on the Beaver River are controlled by the 5 projects listed in the following tabulation (References 5, 6, and 7). The projects, which are the responsibility of the COE, with the exception of Pymatuning Reservoir, effectively regulate 1,005 square miles, 32 percent of the watershed, and have a storage capacity of 302.9 thousand acre-feet. They are effective in reducing flood levels on the Beaver River by an average of 1 to 2 feet (Reference 5).

Beaver River

	Drainage Area (sq. miles)	Date Placed In Operation	Flood Storage Capacity (1,000 acre feet)
Pymatuning Reservoir[1]		1933	
Berlin Lake	249	July 1943	55.8
Mosquito Creek Lake	97	April 1944	33.0
Shenango River Lake	589	February 1967	180.9
Michael J. Kirwan Dam and Reservoir	80	February 1967	33.2

[1] Flood control is in conjunction with Shenango River Lake. Facility is not operated by the COE.

Several dams are located on the Beaver River from its confluence with the Ohio River upstream to the Borough of Eastvale. The dams are water supply structures intended to maintain a constant pool level in normal flow conditions and do not have flood control capability.

Flood warnings and flood-crest forecasts are issued by the National Oceanic and Atmospheric Administration's National Weather Service in Pittsburgh, Pennsylvania, in cooperation with the COE.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood

insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

Analyses of the Beaver River flood flows were developed by the COE. Frequency data were based on the statistical analysis of stage-discharge records at the Beaver Falls gaging station. This information was obtained from the Flood Insurance Study for the Borough of Bridgewater (Reference 8). The gage is located 5.5 miles upstream from the mouth of the Beaver River and has been in continuous operation since 1908.

A summary of drainage area-peak discharge relationships for the Beaver River is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BEAVER RIVER					
At the downstream corporate limits	3,100	57,000	83,000	97,000	137,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along this flooding source.

The COE HEC-2 water-surface profiles computer model was used to estimate elevations of the selected floods and to compute and plot the water-surface profiles at various channel cross sections (Reference 9). The model considers the effect of various hydraulic structures, such as bridges, culverts, and dams. It applies Bernoulli's Theorem for the total energy at each cross section and uses Manning's formula to evaluate the head loss between cross sections. Input requirements include stream cross sections at selected intervals, a starting water-surface elevation for each flood, estimates of roughness coefficients for each reach using Manning's "n", dimensions of hydraulic structures, and the peak discharge for each flood.

The hydraulic analysis for the Beaver River was performed in conjunction with several other Flood Insurance Studies. The analysis covered a 15.5 mile area beginning at the Borough of Rochester-Township of Rochester corporate boundary. Where the Beaver River enters the Borough of Patterson Heights, the starting water-surface elevations were obtained from the study being conducted for the Borough of New Brighton (Reference 10).

Contour maps at a scale of 1:2,400 with a contour interval of 4 feet were developed by aerial photogrammetry for the Beaver River (Reference 11). In addition, surface features and elevations at the cross sections were obtained during interpretation of the aerial photographs. Underwater features and elevations at the cross sections and dimensions of hydraulic structures were obtained during field inspections.

Cross sections were located during field inspections and were based on physical changes along the stream. During these inspections, roughness coefficients (Manning's "n") were selected for channel and overbank areas using information provided by the Bureau of Public Roads (Reference 12). The channel "n" values for the Beaver River is 0.035 and the overbank "n" value is 0.08.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 4 feet (Reference 11). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths of the Beaver River extend beyond the corporate limits of the Borough of Patterson Heights.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Beaver River A	780	492	11,627	8.3	719.8	719.8	720.7	0.9

[1]Feet above corporate limits
[2]This width extends beyond corporate limits

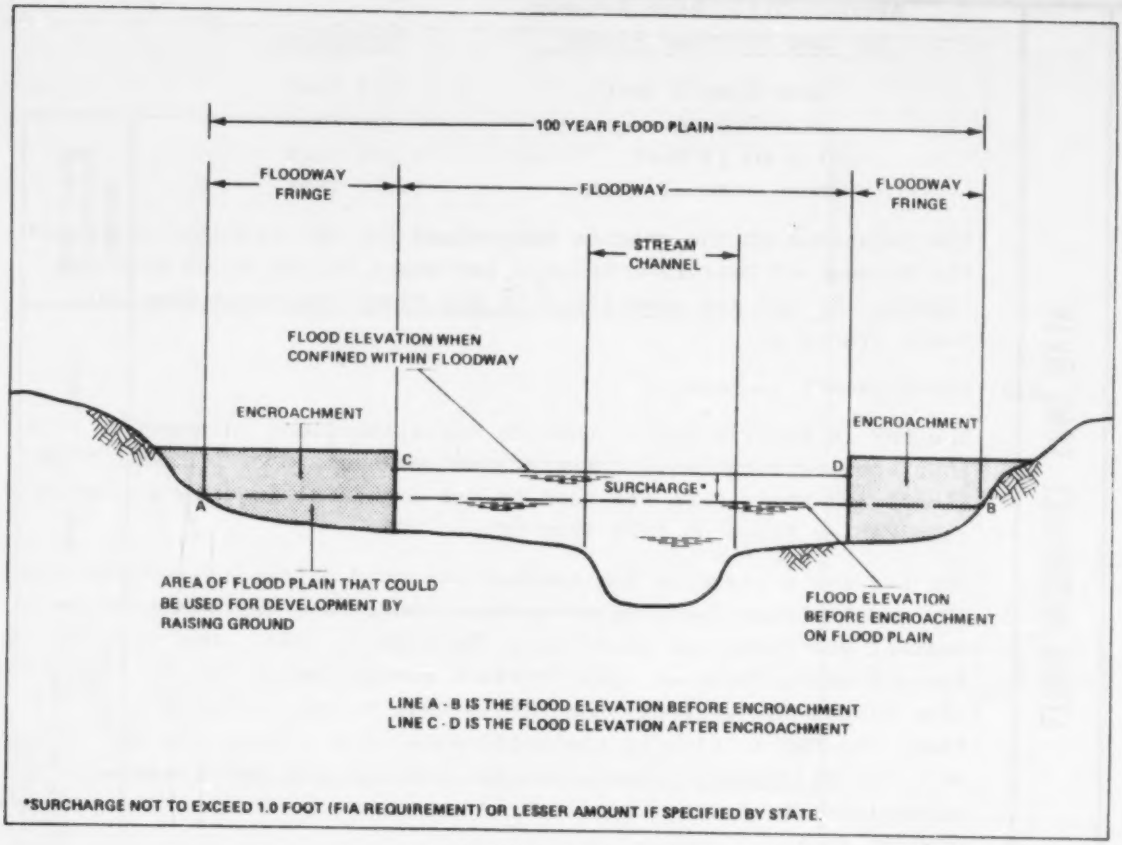
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF PATTERSON HEIGHTS, PA
(BEAVER CO.)

FLOODWAY DATA

BEAVER RIVER


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for the flooding source affecting the Borough of Patterson Heights.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding source of the Borough of Patterson Heights are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Borough of Patterson Heights was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A14: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Beaver River Reach 1	01	-7.0	-1.8	+5.8	070	A14	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
BOROUGH OF PATTERSON HEIGHTS, PA
(BEAVER CO.)

FLOOD INSURANCE ZONE DATA

BEAVER RIVER

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the Borough of Patterson Heights.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Borough of Patterson Heights is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Flood Insurance Studies for the Borough of New Brighton and the City of Beaver Falls are currently being prepared (References 10 and 13). The results of those studies will be in exact agreement with the results of this study. No other studies pertaining to flood problems in the Borough of Patterson Heights were found to exist.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

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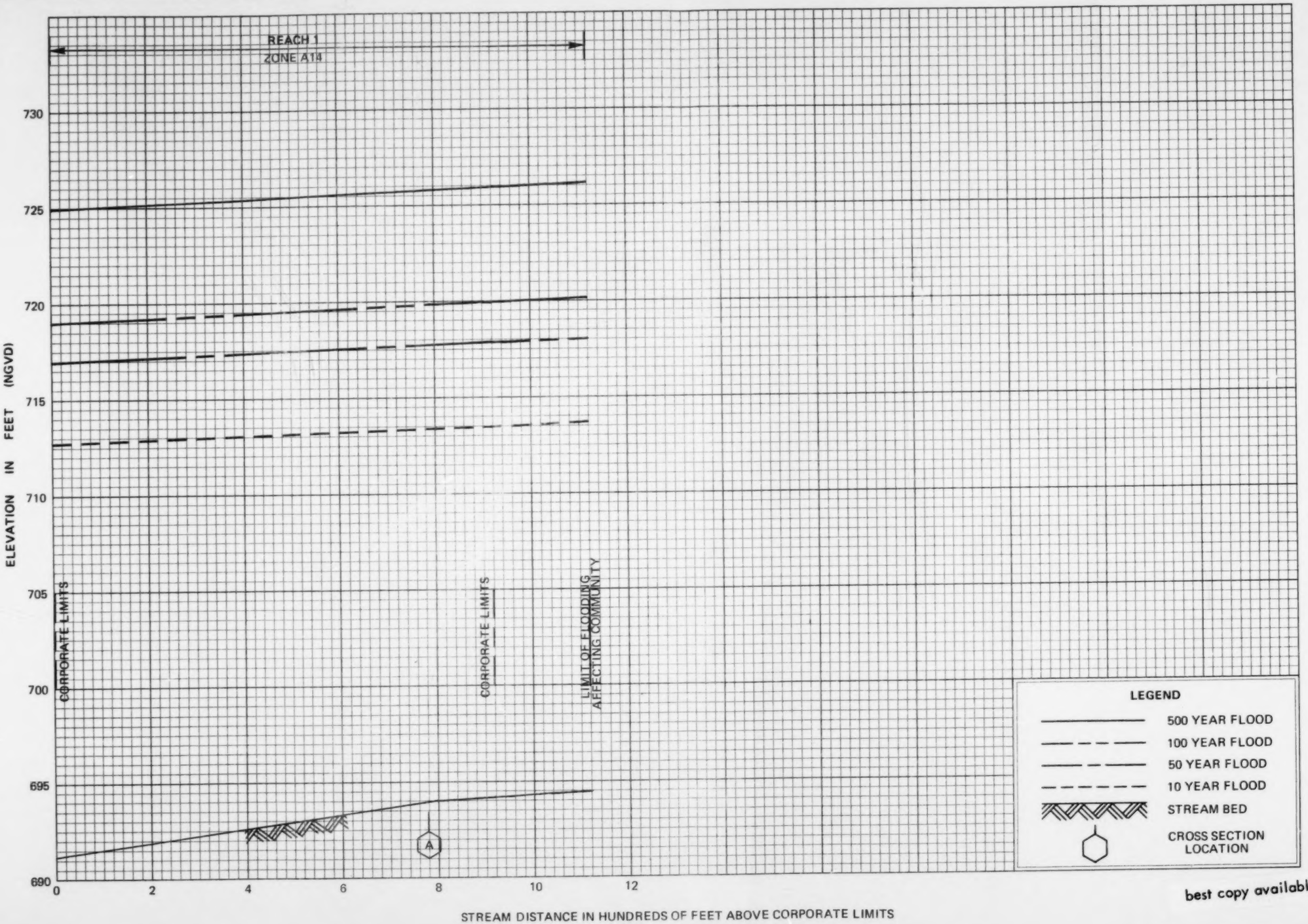

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FLOOD PROFILES

BEAVER RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF PATTERSON HEIGHTS, PA
(BEAVER CO.)

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